UNITED STATES DEPARTMENT OF AGRICULTURE
U.S. Agricultural Marketing Service

SOME SPINNING TEST RESULTS OF INTEREST TO COTTON MANUFACTURERS

By Malcolm E. Campbell, Senior Cotton Technologist

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All the results obtained at the spinning and fiber laboratories of the Agricultural Marketing Service have either a direct or an indirect bearing on the manufacturing quality and utility of American cotton. The problems studied are quite varied in nature, touching upon many fields of work, from the agronomic through the ginning, marketing, and manufacturing phases of the industry. During the past 2 or 3 years, the efforts of the laboratories have been directed largely toward examinations of different varieties of cotton from the quality point of view.

According to the agronomists of the Bureau of Plant Industry, more than 1,200 different varieties or strains of American cotton have been cataloged at one time or another. A few of these are looked upon as basic varieties, possessing their own inherent characteristics, while the rest are merely selections or offshoots of the originally-developed varieties. Moreover, it is not uncommon to find that the name of a particular variety has been changed for commercial reasons, so what may appear to be two or more varieties are, in effect, the same cotton.

Such a situation is, to say the least, confusing to a farmer or group of farmers who wish to select a variety that will give them the best yields and that will also appeal to the spinner. As a result, in most cases the grower selects a variety on the basis of yield per acre and staple length, and too many times the cotton he produces possesses inferior spinning quality. This is no reflection on the grower or the cotton breeder who sold the seed to the planter, as they have had no direct way of determining the spinning quality of their cotton.

To meet this need for information regarding manufacturing quality, several hundred samples of cotton, representing a number of different varieties grown in different sections of the Cotton Belt, have been subjected to careful spinning and fiber studies in the laboratories of this Service. These cottons were produced by the Bureau of Plant Industry in connection with the cotton breeding, production, and improvement program, and in cooperation with various State agencies. The results of the tests

are being made available to Federal, State, and private agencies and to individuals who are interested in them.

From these studies certain varieties have been found to be of consistently high quality, and it is these that the cotton producers are being encouraged to grow, due regard being given, of course, to such matters as yield and cost of production, as well as to probable demand for cotton of specific qualities. There are now upwards of 1,900 one-variety communities in this country, producing more than 2 million bales annually. It is encouraging to note that many of these communities are making every effort to establish a reputation among manufacturers for cotton of high quality. And to a considerable extent the spinning test results being obtained in our laboratories are being used as a basis for the selections of the varieties to be grown.

The Department of Agriculture is anxious to acquaint the manufacturers with these facts, so that they will be able to find the cotton that will best meet their requirements. The results of the spinning and fiber tests, showing how the different varieties of cotton compare at the various locations, will be mailed as they are released, to anyone who sends in a request for them each year. In addition, the Department publishes a list which gives the locations of the one-variety communities and the name of the variety grown by each, which also may be obtained by anyone upon request.

Although a large proportion of our work has recently been concerned with these variety tests, there are a number of other problems to which we have given our attention and which also are of direct interest to manufacturers.

Irrigated versus Rain-Grown Cotton

Our laboratories are, in effect, a proving ground where many developments in the fields of ginning and marketing are tested, and where occasionally an old but still controversial question is settled. Among the latter is the question of the relative quality of irrigated and rain-grown cotton. Probably every manufacturer in this group who uses cotton of 1-1/16 to 1-1/8 inch staple either has tried out irrigated cotton or has attempted to find out how it might serve his requirements. And, if a poll could be taken, it would probably be found that there is a range of opinion regarding the quality of irrigated cotton. Some would say they had found it entirely satisfactory, but others, whether from actual experience or hearsay, would undoubtedly turn "thumbs down" on it. At least, that has been our experience in discussing the problem with many manufacturers.

In any event, the subject has been so controversial and important for so long a time that the Department decided to look into it in a careful, unbiased way. We wanted to find out whether the claims of many manufacturers were well-founded that irrigated cotton was wasty; that the yarns were weak, rough, and neppy; that the fabrics were of poor appearance and

did not dye uniformly; and that, in general, the cotton gave trouble in manufacturing. So, this last year, our laboratories were called upon to make as thorough an investigation of the question as possible with the facilities and personnel available.

Time does not permit a detailed description of the selection of the samples or of the various methods and techniques employed in the tests. For present purposes a brief account of the cottons used and the results obtained will be sufficient. From more than 130,000 commercial bale samples, about 20,000 were selected and composited into test lots, on the basis of the origin, grade, and staple of the cotton. Three general areas were represented, as follows: (1) California; (2) Arizona, New Mexico, and West Texas; and (3) the Mississippi Delta, or parts of the States of Mississippi, Arkansas, and Louisiana. The first two of these areas produce irrigated, and the third, rain-grown cotton. From each area, cottons of three staple lengths for each of four grades were included in the tests. These cottons were spun into yarns, and made into tire cord and sheeting, and samples of the fabric were bleached and dyed. All the different products were tested in many different ways.

The results may be summarized in popular form by the question-and answer method, as follows:

Was irrigated cotton more wasty than rain-grown cotton? It was in the two shorter lengths, 1-1/16 and 1-3/32 inches, but in the 1-1/8 inch length, the Delta samples rather consistently gave up more picker and card waste.

Were the yarns spun from the irrigated cotton weaker? Generally speaking, the California and Delta yarns were near enough alike in strength not to make much difference to a spinner, but the Arizona-New Mexico-Texas yarns were about 5 percent weaker than those of the other two growths.

Were the yarns spun from irrigated cotton of poorer appearance than those from rain-grown cotton? In most cases rather definitely so. The irrigated yarns contained more neps and in many cases were slightly more uneven than the rain-grown cotton yarns. This difference in yarn appearance was, of course, carried into the fabric samples, so that the rain-grown fabrics were easily distinguished, even after bleaching and dyeing.

Did the irrigated fabrics take dye unevenly? No. But the dye absorption of the irrigated and rain-grown fabrics was so different that trouble would result if the yarns of the two growths were allowed to become mixed in weaving fabric that was to be dyed.

Was the irrigated cotton "hard to spin?" No. Although the technologists in the laboratory watched the cotton very closely at every process, no differences could be detected in the manufacturing performance of the two growths.

These are some of the more outstanding results of the tests. They

represent one crop year only, and the study will have to be repeated on one or two more crops before very definite conclusions can be drawn. A detailed description of the tests and results may be found in a report just released by the Department entitled, "Tests of Irrigated and Rain-Grown American Upland Cotton, Crop of 1939."

Drying Cotton Before Ginning

During recent years the practice of passing seed cotton through a hot air drier just before it is ginned has become rather widespread in many parts of the Cotton Belt. Seed cotton that is "green," or that has been picked with the dew on it, or that has been soaked by rain, can now be ginned without long delays. By drying according to the recommendations of the U. S. Cotton Ginning Laboratory at Stoneville, Miss., the ginner can take damp or wet seed cotton directly from the wagon and gin it, with the knowledge that he will obtain a smooth sample of cotton instead of one that is rough or gin-cut because the drier has not been used.

It is natural that mill men and others should raise the question as to what effect, if any, this hot-air drying has on the spinning quality of the lint. This is a matter that has been carefully checked in the Department's spinning laboratories, not for just a single crop year, but for several. Cottons dried at each of several different temperatures before ginning have been spun and tested, and compared with specimens of the same cotton ginned without the use of the drier. The results of these tests have shown that temperatures above 200° F. do definitely result in weaker yarns. This is apparently due to two things, namely, the "baking" and consequent weakening of the fibers, and a measurable shortening of the fibers. But when the recommended temperature of not more than 160° F. is used (and surveys have shown that practically all ginners are careful to follow this recommendation) the grade of the cotton is definitely improved without any appreciable loss in the strength of the yarns. For example, 8 different cottons were ginned both in a green and damp condition and after having been dried with temperatures up to and including 190° F. These cottons, which ranged from 31/32 inch to 1-1/4 inches in staple length, were spun into yarns and tested. On an average, the dried cotton produced yarns that were only 1.16 percent weaker than those spun from the green and damp cotton. Such a decrease would be negligible from any practical standpoint in the manufacture of cotton. At the same time, the amount of picker and card waste removed from the dried samples was found to be somewhat less than that from the undried. This difference was about as much as the average difference between Middling and Strict Middling cotton.

An interesting point to note in connection with the drying problem is the effect of sun drying the seed cotton before ginning. Before the development of artificial driers, many growers and ginners spread damp or wet seed cotton on tarpaulins to dry in the sunlight. Our tests have shown that while such a treatment resulted in excellent preparation or smoothness of the ginned lint, it was extremely harmful to its utility. Large increases in waste, particularly of comber noils, and important decreases in yarn strength resulted consistently. Little or no sun-drying is being done now that the use of artificial driers is so widespread.

Compression of Bales to Different Densities

Some other tests recently conducted in our spinning laboratories that are of interest to manufacturers have to do with the packaging of cotton. A series of investigations now being conducted involve problems of the marketing and handling of cotton from the field to the mill. One important phase of this work deals with the present status and future possibilities of baling.

It appears that one of the factors contributing to the disreputable appearance of so many bales of American cotton is the handling they receive at the compress, where the bales are reduced in size by additional compression so that advantage may be taken of lower freight rates. A promising solution seems to lie in the original compression of cotton at the gin to a density equal to that of present-day standard-density bales. Before proceeding very far with this development, it has seemed desirable to determine what effects, if any, the compression of cotton to different densities at the time of ginning has upon the utility of the lint.

One rather thorough study of this question has already been made in the Service's spinning laboratories. Here, a number of short and long-stapled cottons were tested. An analysis of the results with respect to waste, yarn strength, yarn appearance, and general manufacturing performance revealed only slight differences among the different samples. Although the findings obtained to date appear promising, additional tests must, of course, be made of this factor before sufficient data are obtained as a basis for final conclusions. Furthermore, the question of handling the more densely packed bales must be thoroughly investigated before any changes from the present system are recommended.

The Cutting of Bales During Compression

Probably every mill superintendent who uses cotton packaged in standard or high density bales has, at one time or another, observed the presence of cuts of varying degrees of severity in the cotton. These cuts, which range from an inch or two to 12 inches or more in length and depth, are commonly referred to as "air cuts," on the assumption that they are caused by the rapid expulsion of air during the compression of the bale. It has also been assumed that these cuts, of which as many as 20 have been observed in a bale, are injurious to the spinning value of the cotton.

The subject of bale cutting has been investigated rather thoroughly by this Service in cooperation with the Bureau of Agricultural Chemistry and Engineering. Strangely enough, it was found that these so-called "air-cuts" are not caused by escaping air, but by the shearing action during compression of two adjacent portions of the bale which differ in density. A number of factors have been found to contribute to such cutting, some of which relate to the original formation of the bale, others to mechanical features at the compress, and still others to the condition of the cotton. Now that the causes of the cutting of bales are fairly well known, steps are being taken to eliminate them insofar as is possible.

In the meantime, it has appeared desirable to determine the degree, if any, to which the spinning value of a bale is reduced through the presence of cuts. Three bales, obtained from three different sections of the Cotton Belt, and each containing a large number of severe cuts, were delivered to the Service's spinning laboratory for tests. From each bale a quantity of cotton was drawn which contained the cuts, forming a test lot with a concentration of cuts far in excess not only of a commercial mill mix but also of a single bale of cotton. A second lot was drawn from each bale, consisting only of cotton from the normal, uncut portions. Each pair of lots was subjected to thorough spinning tests.

The results showed that the concentrated sample of cut cotton yielded more waste and manufacturing fly, higher end breakage during spinning, weaker and somewhat more uneven yarns, and weaker tire cord. But these differences were all so small that when they were adjusted to a 500-pound bale of cotton they became insignificant. Thus, even if every bale in a mill mix were very severely cut, which probably never happens in actual practice, the damage would have no noticeable effect in the running of the mill or the quality of the product. It is believed, however, that the psychological effect of cut bales on cotton merchants and spinners justifies a rather concerted effort to eliminate bale cutting altogether. This is particularly true of American cotton in foreign markets, where it has to compete with other growths, most of which are packaged in a far more attractive manner than ours. Accordingly, work is going forward on this problem, with the hope that such bales will eventually disappear from the market.

The subject of bale types and densities, as well as of the cutting of bales, is discussed in detail in a report recently issued by the Service entitled, "The Compression of Cotton, and Related Problems."

Tests of a Triple Hybrid Cotton

All the last three tests discussed gave results that were more or less negative; that is, they showed that from a practical point of view, recommended drying procedure, compression to high densities, and bale cutting do not injure the spinning utility. The fact that the results are essentially negative does not, of course, mean that they are lacking in value. But, lest this general discussion of spinning tests seem rather flat because the results are negative, let us consider some results of a definitely positive nature. In the course of some important genetics research conducted at Raleigh, N. C., by the cooperating Bureau of Plant Industry, a triple hybrid cotton was produced by crossing an Asiatic cotton, a lintless variety, and a well-known upland variety. (The chromosome numbers of the first two were doubled, from 13 to 26, with the use of colchicine, before being crossed with the upland cotton, which has 26 chromosomes.) X-ray tests were made of lint of the first generation, and the results were so unusual that it was planned to produce enough lint for a small-scale spinning test. Accordingly, a limited quantity of the triple hybrid was grown and ginned on a small laboratory gin, and the lint sent to the spinning laboratory for tests.

Most mill men know what to expect in the way of strength for 30s carded warp yarn. As a rule, a skein strength of about 65 pounds will mean good spinning and weaving for print cloth. Let us, therefore, see what this new cotton would do if spun into print cloth warp. Making allowances for staple length and yarn count, it is calculated that if the triple hybrid were 1-1/16 inches long, it would produce 30s carded warp breaking at 106 pounds.

Actually, the hybrid was 1-5/32 inches in staple. It produced 22s yarn with a skein strength of 166 pounds, which was 45 percent stronger than the average figure which we have obtained for different commercial cottons of this length. In finer counts the yarns of the new hybrid were relatively even stronger.

The results of this test are cited here, not to leave the impression with practical mill men that their troubles are over, because several years will necessarily elapse before it can be determined whether this cotton will have commercial possibilities. Rather, this work is mentioned to show what <u>can</u> be done with cotton experimentally. These results are, however, highly important and encouraging, particularly since no less striking things have already been carried out in a practical and large-scale manner with corn and other agricultural products.

The Bureau of Plant Industry, the various State experiment stations, and the commercial cotton breeders of the country have thousands of selections and progenies in their cotton breeding blocks that possess a great variety of fiber properties and possible use values. Regardless of the outcome of this new development, it is believed that the present method of testing these samples is bound to give us better cotton in the future.